2. Other Initial Electron Ring Issues:

These issues need to be addressed in the early stage of the design.

Require efforts from experiment, accelerator physics and engineering .

- IR region design.
- Synchrotron radiation linear power load limit.
- Beam size matching, round electron beam.
- Energy flexibility.
- Spin direction reversal
- ….

21. IR region design:

Vertical or horizontal separation.

This choice will have impact on lattice design especially dynamic aperture and achievable polarization level?

E.g. the May 2002, vertical separation design (Alexei, Dimitry) has $\beta x > 2000m$ compare to horizontal separation $\beta x \sim 600m$.

2.2 Synchrotron radiation linear power load limit.

0.45A:13 KW from dipoles at 10 GeV, 19 KW at 12 GeV.

(SLAC HER 10 KW/m by design,

super-KEKB HEB 8 GeV design=> 25 KW/m)

Ask for 15-20 kw/m limit? Higher limit technically possible

with higher cost.

Need engineering evaluation.

2.3 Beam size matching, round electron beam?

Proper way to produce round electron beam, without effects on polarization.

Merits of RCB(round collider beam) => VEPP2M test.

Bates SHR round beam test (effect on polarization).

2.4 Energy flexibility

2.4.1 > 10 GeV

- Linear power load of synchrotron radiation.

  Fix linear power load limit. Then as $P \propto E^4$, E $\uparrow$,

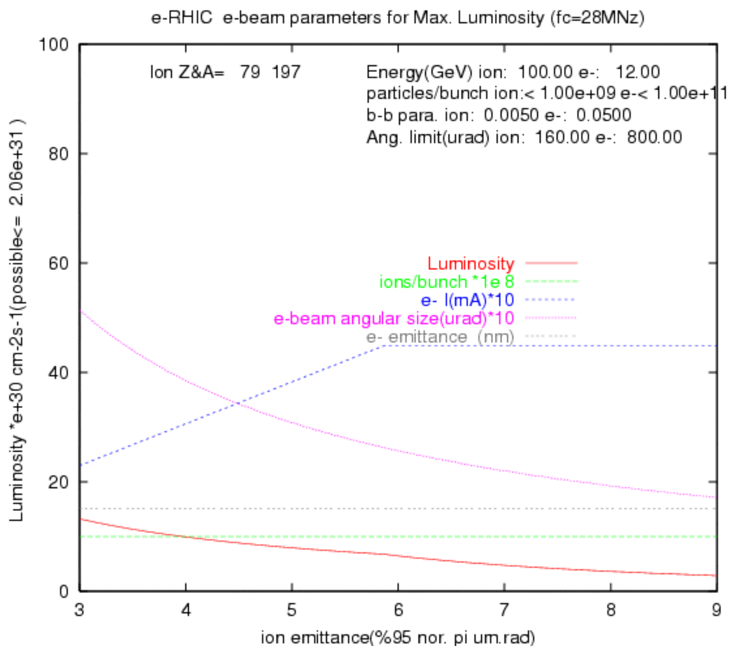
  electron current $\downarrow$ =>$I \propto E^{-4}$.

  With optimal e- emittance, may reduce e- I requirement.

  So at 12 GeV with I=0.25A, the linear power load will be 15 KW. This may be acceptable.

- RF: Electron energy loss per turn $U_0 \propto E^4$. Vrf = Over voltage $*U_0$. One of the major impact on cost.

100 GeV/u gold vs. 12 GeV electron (Small e- emittance ~ 15 nm)



- Luminosity 1.32 e31
- I_e=230 mA
- ε_x ~ 10 nm (at 10GeV)
- E loss/turn=26.7MeV

  Cost !
- P_{linear}= 14.4 KW/m

- **Spin direction at IP with solenoidal spin rotator.**

  If at energy=E_o, beam polarization is pure longitudinal at IP.

  For $E=E_1$, the spin vector angle respect to collision axis:
  $\alpha=90*(E_1/E_0-1)$.

  Spin longitudinal projection at IP: $\cos(\alpha)$.

  E.G. if E0=7.5 GeV, at 5 or 10 GeV , the reduction will be 15%.

  E0=8.5GeV, the reduction will be 20% at 5 or 12 GeV, and 4% at 10 GeV.

  It is flexible to choose proper $E_{0,}$ up to what experiments ask.

- **Self –polarization time.**

  If injection energy is limited at 10 GeV, then have to ramp energy up. And self-polarization mechanism will apply. The self- polarization time for the present design is about 15 minutes at 10GeV. For higher energy it will be much short as the build –up rate $\tau^{-1} \propto E^5$. *No problem.*

Observations for > 10 GeV run

- To run energy higher than 10 GeV, the main problem is to require higher RF voltage and to deal with higher linear radiation power load.
- Energy increase to 12 GeV may be acceptable without much compromise to luminosity reduction.
- Further high energy run will add significant cost and technical complexities.

2.4.2 < 5GeV

- Use existing spin rotators, set IR point spin pure longitudinal at 7.5 GeV.

  Spin longitudinal projection => cos(α):

E	2	3	4
cos(α)	0.41	0.59	0.74

- Use single 180^0 spin rotator, keep spin in horizontal plan and longitudinal at IR with polarized injected beam.

  Depolarization time: ~ 1.2 $C\rho^2/E^7$, for E>> 0.44GeV.

  C~1200m, ρ~68m:

  2 GeV ~ 15 hours, 3 GeV 0.85 hours.

2.5 Spin direction reversal.

- Long time run with reverse spin direction at IP:

  Reverse spin rotator direction only. Spin direction in arc will be the same, keep ST polarization working.

  Reversing time (cycle relevant magnets + inj.) ~ 10 minutes.

- Fast spin flip with rf dipole spin flipper. Spin direction in arc will be reversed.

  The rf dipole field strength is independent of electron energy.

  Success at Bates SHR ~99% efficiency.

  So spin direction will stay << spin relaxation time~ ST time.

- Short period test: Reverse source polarity. Spin direction in arc will be reversed.

  Only the short period << spin relaxation time,

  and with inj.+ stacking time in ~ seconds.

2.6 Positron?

2.7 Polarimeter locations.

2.8 Other requirements from physics…. We are waiting.